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BY A. P. C.

J. F. G. CHOBERT

TUBULAR RIVETS AND LIKE HOLLOW ELEMENTS AND TO METHODS OF FIXING THE SAME

Filed Feb. 16, 1938

Serial No. 190,868

2 Sheets—Sheet 1

Fig. 1.

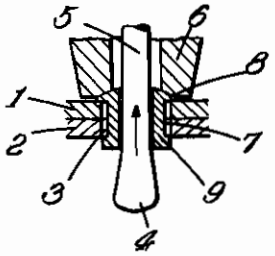

Fig. 2.

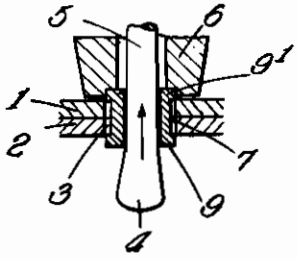

Fig. 3.

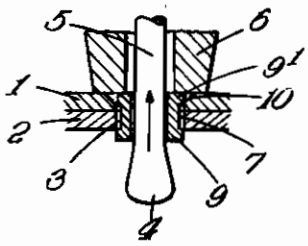

Fig. 4.

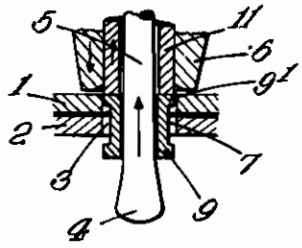

Fig. 5.

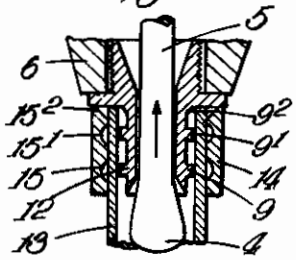

Fig. 6.

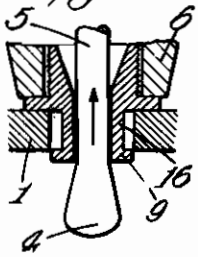

Fig. 7.

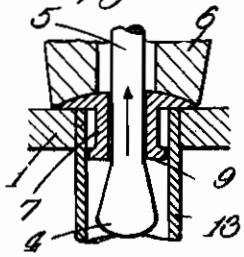

Fig. 8.

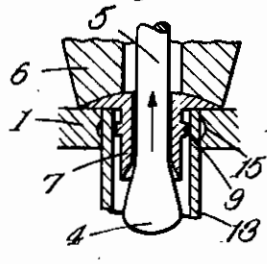

Fig. 9.

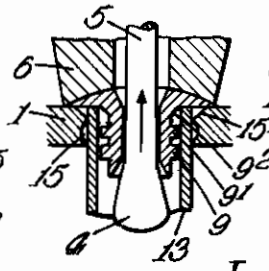

Fig. 10.

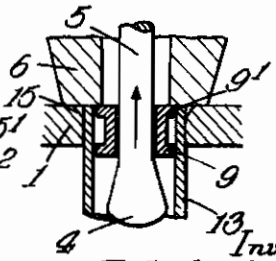

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Fig. 11.

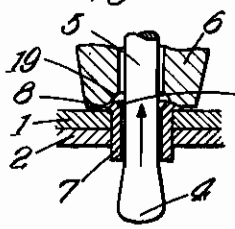


Fig. 12.

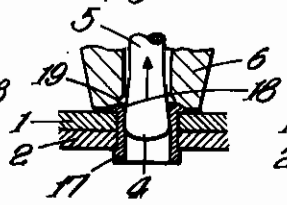


Fig. 13.

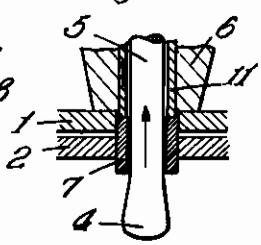


Fig. 14.

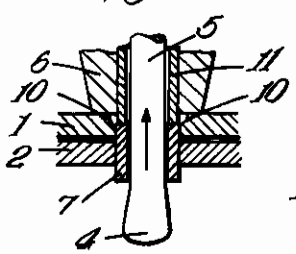


Fig. 15.

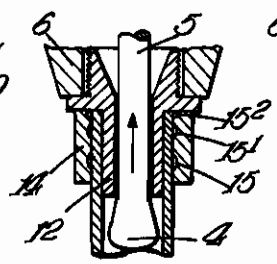


Fig. 16.

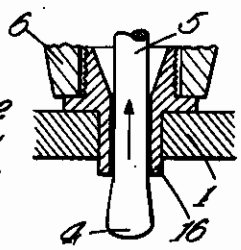


Fig. 17.

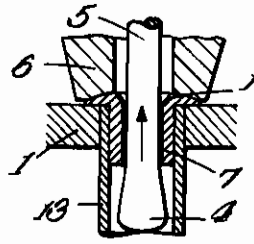


Fig. 18.

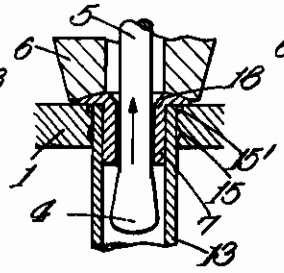
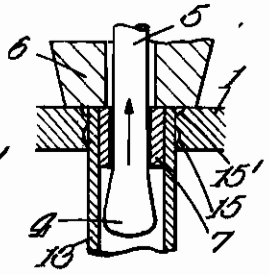


Fig. 19.



Cancelled Oct 25, 1938

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ALIEN PROPERTY CUSTODIAN

TUBULAR RIVETS AND LIKE HOLLOW ELEMENTS AND TO METHODS OF FIXING THE SAME

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Application filed February 16, 1938

The present invention relates to tubular rivets, unions and like hollow elements and more especially to those adapted to be secured by being upset by a headed mandrel which is forced through the interior thereof to perform the upsetting operation and also to methods of fixing such elements.

Hollow elements of this type having one or more internal collars or annular beads are known but are expensive and difficult to manufacture and are not easily gauged to ensure accuracy of dimensions. An object of the present invention is to provide hollow elements of this type which are more easily manufactured, are less costly to produce and are more easily gauged.

According to the present invention the internal bore of the hollow element is smooth and is of substantially uniform diameter. In one form in accordance with this invention the shank of the hollow element is provided on its exterior with one or more annular beads or collars which, when the element is upset by the mandrel, are forced outwards to secure the element in position.

In another form also in accordance with the present invention both the interior and exterior of the shank of the hollow element are of substantially uniform diameter. The mandrel is of greater extreme diameter than the internal diameter of the element and in performing the upsetting operation the body of the element is expanded to engage the member or members to which the element is to be secured.

The uniform internal bore of the hollow elements according to the present invention facilitates manufacture of the elements. The smooth bore left after the upsetting operation facilitates the closing of the rivet by a plug or the like and offers little frictional resistance to flow of liquids.

The formation of external collars or annular beads on the hollow element is considerably less expensive than the formation of such collars on the interior and such exterior collars can be more accurately machined and are more easily gauged to ensure accuracy.

In the alternative form of hollow element the external collars are omitted and the shank of the element is smooth and is of uniform diameter, the walls being slightly increased in thickness to provide extra metal for securing the element.

The present invention will be more fully described hereafter with reference to the drawings which show by way of example various embodiments thereof as applied to tubular rivets, unions and to the securing of tubes to plates.

In the drawings:

Figs. 1 to 10 show examples of the use of the first form of hollow element in accordance with the invention having external collars, while Figs. 11 to 19 show examples of the use of the second form having a smooth exterior.

Figs. 1 to 3 are sectional views showing tubular rivets with different shapes of head.

Fig. 4 shows the application of the form of rivet of Figs. 2 and 3 to securing together plates which have become slightly separated.

Figs. 5 and 6 are sectional views showing unions for fixing to tubes and to plates respectively.

Figs. 7 to 10 are sectional views showing the use of various forms of this type of rivet for securing tubes to plates.

Figs. 11 and 12 are sectional views showing successive stages in the upsetting of a tubular rivet of the second type.

Figs. 13 and 14 are similar views showing two forms of headless rivet used to draw two plates together.

Figs. 15 and 16 are sectional views showing unions of the second type.

Figs. 17, 18 and 19 show three ways of securing a tube in a plate using the second type of rivet.

One of the forms of rivet with an external collar is shown in Fig. 1, in which **1** and **2** are the plates to be secured together by the rivet which is inserted in a hole **3** therein; **4** is the conical head of the upsetting mandrel the stem **5** of which may be gripped in the jaws of the riveting machine to displace it in the direction of the arrow; **6** is the nose of the riveting machine, which is pressed against the head **8** of the rivet. The rivet **7** has a head **8**, a cylindrical shank **7**, and an external collar **9**.

The diameter of the head of the mandrel is greater than the internal diameter of the rivet and is preferably intermediate between the internal and external diameter thereof and is so designed that the upset rivet completely fills the hole **3** in the plates **1** and **2**.

When the mandrel is drawn through the rivet, it first expands the collar **9**, which grips the under side of the plate **2**, all round the hole **3**. The mandrel then expands the shank of the rivet to fill completely the free space between the walls of the hole **3** and the shank of the rivet.

When the mandrel has passed completely through the rivet, the plates are firmly connected together.

The head of the rivet may be of any convenient shape, for example chamfered as shown in Fig. 1.

Fig. 2 shows an alternative form of rivet in which the head 8 of the type of rivet shown in Fig. 1 is replaced by an upper expansion collar 9^1. This symmetrical design of the rivet facilitates production, and enables the rivets to be mounted automatically on the mandrels of the riveting machines, since they can be threaded thereon either way up. In passing through the rivet, said mandrel first expands the lower ring 8, which grips the under-side to the plate 2, then expands the shank 7, which completely fills the hole 3, and finally expands the upper collar 9^1 which grips the plate 1 and forms the head of the rivet.

Fig. 3 shows a rivet of the same type, the upper plate 1 being countersunk at 10, to receive the upper expansion collar 9^1 when the later is expanded. With this form, no part of the rivet projects above the surface of the plate 1 after upsetting. Should it also be desirable for the rivet not to project below the plate 2, the latter may be similarly countersunk.

The form of rivet shown in Figs. 2 and 3 may in addition to its normal applications be used to secure together plates which have become slightly separated, this not being possible with tubular rivets of known construction having a preformed head. An example of this is shown in Fig. 4 in which the lower plate 2 has become slightly separated from the upper plate 1.

For this purpose it is necessary to employ a special fixing machine with a two-fold movement. The rivet 7 is placed on the mandrel 5 of a machine having two work-positioning noses, the inner one, 11, being adapted to be extended beyond the outer nose 6 by a distance exceeding the space that may exist between the plates to be drawn and secured together. The assembly is then passed through the hole 3 in the plates so that the lower collar 9 of the rivet 7 projects below the lower plate 2, it is necessary for this purpose that the greatest external diameter of the rivet should be less than the diameter of the hole 3.

When the mandrel is drawn upward by the riveting machine the upper end of the rivet butts against the inner nose 11 of the machine allowing the head 4 of the mandrel to expand the lower collar 9, the external diameter of which is increased and becomes greater than that of the hole 3 provided in the plates.

The inner nose 11 of the riveting machine is then released, and retracts within the outer nose 6 which is drawn into contact with the plate 1. The mandrel draws up the rivet but, since the lower collar 9 has been expanded, said collar can no longer pass through the hole 3 in the plate 2, and consequently raises said plate and presses it against the plate 1.

When the two plates are pressed together the mandrel is obliged to pass through the rivet, expanding the shank 7 to fill the hole 3 in the plates and then expanding the upper collar 9^1 thereby causing it to grip the upper plate 1.

If desired the upper and/or the lower surfaces of the plates may be chamfered as indicated in Fig. 3.

The application of this invention to a union is shown in Fig. 5.

The union 12 may have a threaded portion which projects beyond the tube 13 to which it is to be secured, and has a cylindrical portion which enters the tube and is provided with one or more exterior expansion collars.

The union shown in Fig. 5 has two expansion collars 9 and 9^1 and a short conical section 9^2. The tube 13 is inserted in a reinforcing ring 14 provided with three annular recesses 15, 15^1 and 15^2 corresponding in position with the collars 9, 9^1 and 9^2 respectively.

The head 4 of the upsetting mandrel, has a diameter greater than the internal diameter of the cylindrical shank of the union, and, in passing through the union expands, firstly, the collar 8 (which forces the tube into the recess 15), then the cylindrical portion and a second collar 9^1 (which forces the tube into the groove 15^1) and the remaining cylindrical portion, and finally the conical section 9^2 which forces the tube 13 into the corresponding recess 15^2 in the ring 14.

The expansion collars may be of any desired number and shape, and the same applies to the facing annular recesses provided in the ring 14, These unions may also be fixed without any exterior ring.

Fig. 6 represents a union 16 with an external expansion collar 9 for fixture to a plate 1.

During the upsetting operation the union 16 is held in position by the nose 6 of the riveting machine. The mandrel 4, in passing through the union 16, first expands the collar 9 (which grips the under side of the plate 1), and then expands the cylindrical shank of the union to fill the hole in the plate 1.

When the mandrel has passed completely through, the shank 16 makes a perfectly tight joint with the plate 1.

This type of rivet having external expansion collars may be used to secure tubes to plates as indicated hereafter.

Fig. 7 shows an example of this method of fixing, 13 indicating the tube to be secured to a plate 1. A headed rivet 7, with an external expansion collar 9 is inserted in the tube.

The head of the rivet is pressed against the plate 1 by the nose 6 of the fixing machine. In passing through the rivet, the mandrel, the head of which has a diameter greater than the internal diameter of the shank of the rivet, expands the collar 9, which deforms the tube and causes it to engage the lower surface of the plate 1.

The mandrel then expands the cylindrical shank 7 of the rivet, pressing the outer face of the tube against the wall of the hole in the plate 1.

Fig. 8 shows another example in which the expansion collar 9 of the rivet occupies a position within the thickness of the plate 1. The hole in which the tube 13 is to be secured is provided with an annular recess 15 on a level with the collar 9 of the rivet, so that, in passing through the rivet, the mandrel expands the whole of the latter, and the collar 8 forces out the tube to fill the free space in the recess 15. The tube 13 is more firmly secured than in the case of the preceding example.

Fig. 9 shows a further example in which the rivet is provided with two expansion collars 9 and 9^1 and with a short conical section 9^2.

In passing through the rivet, the mandrel expands the first collar 9, which distends the tube 13 against the under side of the plate 1. It next expands the cylindrical portion, and then the second collar 9^1, which forces the tube into an annular recess 15 provided in the hole of the plate 1. Continuing its stroke, the mandrel expands the cylindrical portion, and then the conical section 9^2, which forces the end of the tube into a corresponding recess 15^1 provided in the upper face of the plate. The tube is thus secured very firmly to the plate.

The bore of the rivet may be relieved as indicated at the upper end to prevent any metal drawn up by the passage of the mandrel from protruding beyond the head of the rivet.

Fig. 10 shows an example in which the rivet 7 employed to secure the tube 13 is symmetrical and headless being provided with two expansion collars 9 and 9^1. The manner in which the tube is secured, will be easily understood from the description of the preceding examples.

To give increased strength a third collar might be arranged between the collars 9 and 9^1 to force the tube into an annular recess provided about midway of the thickness of the end plate 1. In the embodiment shown, the upper end of the hole is chamfered as indicated at 15 to receive the upper expansion collar 9^1.

All the rivets with outside expansion rings have the disadvantage that the rivets must be arranged to correspond exactly with the thicknesses of the plate or plates to be secured.

The second form of hollow element according to the present invention differs from the first in that the external expansion collars of the first form are omitted. This form has an advantage over the first form that a given element can be used for a variety of thicknesses of plate as there is no necessity for exact correspondence between the axial dimensions of the rivet and the thickness of the plate or plates

Fig. 11 shows an example of the second type of hollow element in which a rivet 7 is a simple cylindrical tube provided with a head 9 which may be of any convenient shape.

The internal diameter and the thickness of the walls of the rivet are dependent on the amount of the rivet which is to be expanded outwards to secure it in position, the external diameter normally being generally the same as that of the hole in which the rivet is to be secured. The diameter of the head of the upsetting mandrel is equal to the final internal diameter of the rivet when upset and is preferably intermediate between the external and internal diameters of the shank of the rivet.

The nose 6 of the riveting machine presses the head of the rivet firmly on to the plate 1. When drawn through the rivet, the mandrel easily expands that part of the rivet which is below the lower plate 2, causing an annular bulge 17 (Fig. 12). The mandrel then expands the shank of the rivet pressing the walls outwards against the walls of the hole 3 and causing an upward flow of the metal. The head of the rivet is recessed at 19 (Fig. 11), to allow the upward displacement of the metal; and the nose 6 of the machine is provided with an annular recess 19 into which the metal can also flow.

It will be evident that a rivet of this type can serve to secure various thicknesses of plate, the height of the annular bulge 17 simply varying according to the thickness to be gripped.

This rivet is extremely easy to produce by machining or pressing, and is also very easily gauged to ensure accuracy.

Fig. 13 shows another example of the invention in which the rivet is a simple tubular member, the head as well as the tail being deformed in the upsetting operation to secure the rivet.

In order to fix this form of rivet for the purpose of securing together plates which have become separated it is necessary, as in the case of the rivet shown in Fig. 4, to employ a machine with double concentric nbses 6 and 11.

The rivet 7 is threaded on the mandrel 4, the inner nose 11 of the machine bearing against the upper end of the rivet and the assembly is then inserted into the hole in the plate 1, so that the lower portion of the rivet projects below the plate 2. The mandrel then expands the portion of the rivet which extends below the plate 2.

When a length of 1–2 millimetres of this portion of the rivet has been expanded, the inner nose 11 is released and is retracted within the outer nose 6.

On continuing to ascend, the mandrel draws upward the rivet 7 and the plate 2, which latter is pressed against the plate 1. When the two plates are in contact the noses 6 and 11 of the riveting machine bear against the upper plate 1 and the rivet respectively; the mandrel is then drawn completely through the rivet 7 and expands it, thus securing it in position.

Fig. 14 shows a modified arrangement in which the upper plate 1 is countersunk as indicated at 18 to receive the expanded head of the rivet.

Fig. 15 shows this form of the invention as applied to a union. The union 12 is inserted in a tube 13 which is surrounded by a reinforcing ring 14 provided with annular recesses 15, 15^1, 15^2.

In passing through the cylindrical portion 12 of the union, the head of the upsetting mandrel tends to expand the union and tube against the reinforcing ring and since the head is of greater diameter than the bore, it displaces some of the metal of the union upwards in front of it, thus forcing the metal of the tube outwards below said ring and also into the annular recesses 15, 15^1 and 15^2 provided in said ring.

The annular recesses may be of any number and shape. The interior of the union fixed in this manner is exceedingly smooth.

Fig. 16 shows a hollow union 16 to be fixed in a plate 1. As in the other case, the head of the mandrel has a diameter intermediate between the internal and external diameters of that portion of the union which is enclosed in the plate 1.

The union 16 is held in position on the plate 1 by the nose 6 of the riveting machine. In passing through the union 16, the head 4 of the mandrel expands the cylindrical portion, causing the metal to bear against the lower surface of the plate 1. The mandrel then expands the portion embedded in the thickness of the plate 1, and presses it into intimate contact with the plate.

Unions of this kind are far more quickly and economically produced than in the case of unions provided with an expansion ring, such as shown in Fig. 6. Moreover, unions and like hollow bodies of this type may be fixed on plates of widely differing thickness.

This type of cylindrical rivet expanded by the passage of a mandrel having an enlarged head, the diameter of which is intermediate between the internal and external diameters of the rivet may also be used to secure tubes to plates.

Figs. 17 and 18 show examples of this method of securing a tube 13 with a headed tubular rivet 7.

The rivet 7 is inserted in the tube 13 which, in turn, is inserted in a hole in a plate 1.

In the embodiment shown in Fig. 17, the hole in the plate is smooth, whilst in that shown in Fig. 18 the hole is provided with two annular recesses in which the tube becomes embedded under the outward thrust of the metal of the rivet during the upsetting operation.

The head of the rivet is preferably countersunk as indicated at 16, to accommodate the

metal forced upwards by the head of the mandrel during the upsetting operation.

In passing through the rivet 7, the mandrel expands the latter, causing the tube to expand and engage the under-side of the plate 1.

The mandrel then expands the tube outwards against the walls of the hole in the plate. In the case of the arrangement shown in Fig. 18, the metal of the tube is also forced into the annular recesses provided in the interior of the hole in the plate.

Fig. 19 shows an alternative arrangement in which the rivet is headless and consists of a cylindrical member. This rivet offers all the advantages of the plate rivets shown in Figs. 13 and 14.

From the foregoing examples, it will be readily evident how this rivet may be used to secure the tube 13 in the end plate 1, when the rivet is upset the tube is secured to the end plate by engagement with the lower side of the plate and also with the recesses in the hole.

The shape of the recesses in the hole and also their number may be modified as desired, a tube may even be secured in a plain hole in the plate by a rivet of this type but this provides a less secure fastening than the arrangements above described.

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